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(54) **Optical record disc**

(57) A transparent disc 1 carries a reflecting crenellated information structure 2 which is bonded to a flat heat-conducting plate 6, for example an aluminium plate, to reduce the amount of local heating, with consequent degradation of the information structure 2, which may be caused by the playback beam.

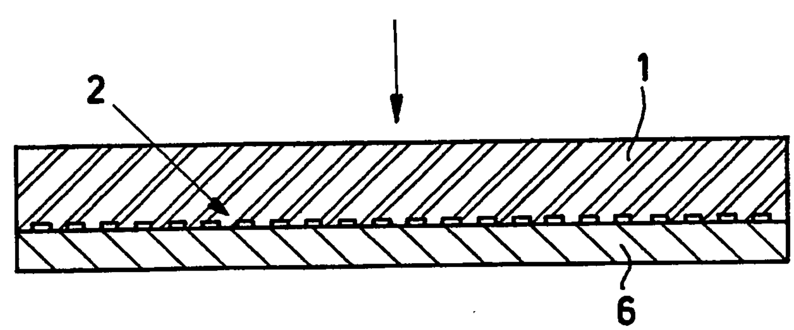

Fig.2

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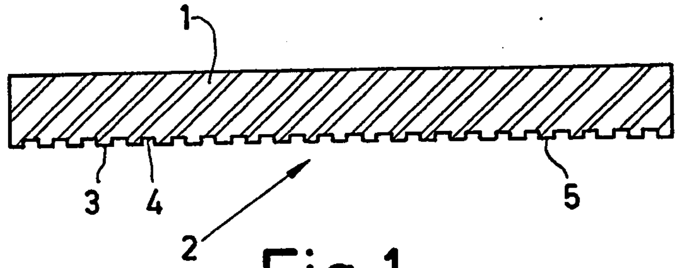

Fig.1

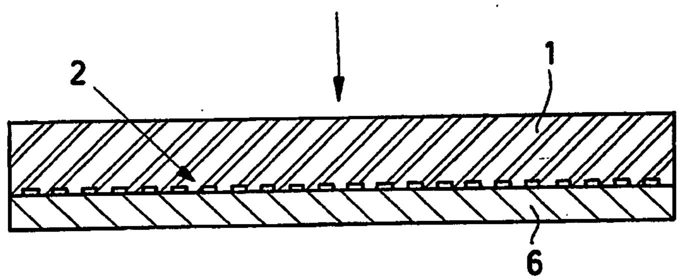

Fig.2

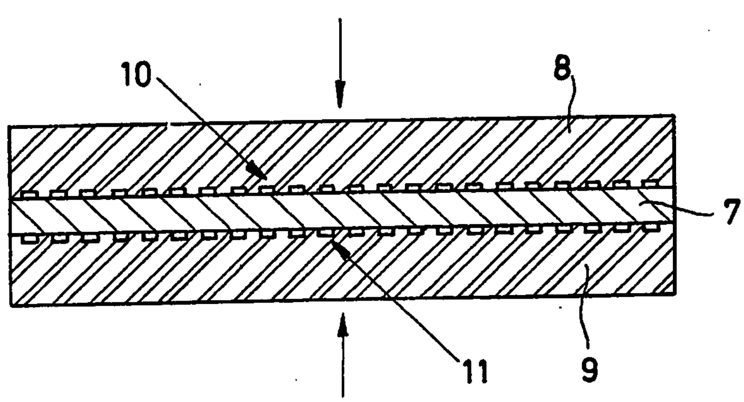

Fig.3

SPECIFICATION

Optical record disc

THE INVENTION relates to a method of manufacturing an optically readable information disk, in which a transparent plastics information carrier comprising a radiation-reflecting optical structure on one side is provided, on the side of the optical structure, with a cover plate bonded thereto by means of an adhesive.

Such a method is known from Patent Specification No 1,466,009 (PHN 6493).

The disadvantage of the known method is that the optically readable information disks manufactured according to the method will show defects or deviations in the optical structure some time after manufacture, so that the quality of the stored information, for example, video information or audio information, is reduced.

All the optically readable information disks manufactured so far from a plastic synthetic resin have the above disadvantage. To improve this, search has been made for special compositions of synthetic resins showing the desired stability for longer periods of time and in varying climatological conditions. In this connection it is to be noted that very stringent requirements have to be imposed on the stability of a plastics information disk in view of the minute detail of the information structure. As stated also in the above Patent Application, said structure usually consists of radiation-reflecting areas, arranged in tracks, of very small dimensions, in the order of magnitude of 1μ. These areas are, for example, small blocks and intermediate areas situated in one plane, the coefficient of reflection of the blocks differing from that of the intermediate areas. The optical structure preferably consists of small blocks and intermediate areas having the same coefficients of reflection, the blocks and intermediate areas being situated at different levels. Thus a crenellated structure of the information tract is obtained with a difference in height between the blocks and the intermediate areas of approximately 0.5μ. The information track may be spiral-like or be constructed from concentric circles.

The radiation-reflecting optical structure is read in reflection by means of a focused light beam, in particular laser light.

Plastics information disks having a reflecting optical structure on one side can be mass-produced using matrices defined herein as master surfaces bearing the crenellated structure. Various methods may be used, for example a pressing process described *inter alia* in Patent Specification No 1,447,066 (PHN 6519C). Another known method is an injection moulding process or a moulding process. German Offenlegungsschrift 24 43 020, for example, discloses a moulding process in which a liquid polyurethane resin with a polyester substrate thereon is applied to a matrix of silicone rubber. After the urethane resin has cured, the substrate with the cured polyurethane layer connected thereto is removed from the matrix surface. Another method of manufacturing is the so-called printing process, in which a thermoplastic foil is provided with the desired optical structure by being applied to a rotating matrix which is provided, for example, on a roller.

The resulting information disks are then provided, on the side of th optical structure, with a radiation-reflecting layer, for example, a layer of metal or a layer of a selenide dielectric. A suitable radiation-reflecting layer is, for example, a layer of aluminium, silver or gold provided by vapour deposition or by electroless plating. In order to protect the radiation-reflecting layer from chemical and mechanical attack, a protective layer of plastics is provided hereon. This usually is a layer of lacquer, but according to the above Patent Specification No 1,446,009, it may alternatively be a thin sheet or foil provided with an adhesive.

Another known method of manufacturing information disks having a reflecting optical structure on one side starts from a substrate in disk form on which a reflective layer is vapour-deposited *via* an apertured mask. So in this method no matrix is used. Instead of a vapour deposition process, an etching process may alternatively be used, in which a layer of photoresist provided on a metal layer is exposed to light *via* a mask and is developed, after which the exposed parts of the metal layer are etched away. These latter methods are considered to be less suitable for mass-production.

Efforts have been made to remove the above disadvantage of reduction in quality of the optical structure by making such improvements in the manufacturing technique that the pressure load and thermal load exerted on the synthetic resin are minimum. It has been suggested, for example, in the pressing process and the printing process, to heat only the uppermost layer of the synthetic resin in which the information structure is to be provided.

The invention provides a method of manufacturing an optically readable information disk, in which a transparent plastics information carrier comprising a radiation-reflecting optical structure on one side is provided, on the side of the optical structure, with a cover plate bonded thereto by means of an adhesive, characterized in that the cover plate is a flat, substantially rigid, heat-conducting plate manufactured from inorganic material and bonded to the information carrier over all its surface.

The invention is based on the insight that the reduced quality of the information disk is mainly the result of micro-structured forces, i.e. forces which act over very small distances on the information disk and which are released upon reading the disk by means of laser light.

The laser light beam focused on the optical structure of the information disk will traverse the transparent synthetic resin without noteworthy loss of light energy and will then be reflected by the radiation-reflecting layer. Dependent of the coefficient of reflection of the reflecting layer used, — generally a metal layer — more or less light energy will be absorbed by the reflecting layer. The absorbed light energy is converted into thermal energy; as a result of this the temperature of the layer will rise locally, which in turn produces a local heating of the part of the optical structure engaging

the reflecting layer. Many internal stresses are present in the part of the information carrier comprising the optical structure. In connection herewith it is to be noted that in the above-described manufacture of plastics information carriers which are provided with an optical structure on one side only, a thermal load and a pressure load are exerted on the thermoplastic material to be processed. This is the more prominent in a pressing or printing process, in which the optical structure is provided in a heated thermoplastic synthetic resin under pressure from a matrix. On cooling, the internal stresses introduced into the material under the influence of pressure and heat are frozen-in. Such internal stresses occur frequently and, in particular, in that part of the synthetic resin where the deformation is maximum, in other words in or near the optical structure.

Internal stresses are present even in the information carriers manufactured according to methods of manufacturing plastics information carriers in which no high pressures or temperatures are used. In this connection, reference is made to Patent Specification No , , , Patent Application No 42482/77. The process described in said Application starts from a liquid lacquer which can be cured with light, for example U.V.-light and which is spread over the information-carrying surface of a metal matrix. A transparent plastics sheet is then provided over the lacquer, after which the lacquer is exposed to light *via* the plastics sheet, cured and finally the assembly of plastics sheet and the information-carrying cured lacquer layer connected thereto is removed from the matrix surface.

The plastics information carrier thus manufactured also shows internal stresses, especially in the plastics sheet which, during the manufacture thereof, for example, by means of an extrusion process, has also been subjected to a pressure and thermal treatment.

As already stated hereinbefore, very local heating of the plastics information carrier in or near the optical structure takes place when the information disk is exposed to laser light. The heated surface area is very small, in the order of magnitude of microns. The stresses present in the heated part of the information carrier will be released and the forces resulting herefrom will produce a deformation, however small in dimension. In view of the minute detail of the optical structure, this results in errors in the stored information.

By using a heat-conducting plate upon irradiating the optical structure with laser light, the energy absorbed by the reflecting layer will flow for the greater part to the heat-conducting plate so that no noteworthy rise of temperature will occur at the area of the irradiated surface. The information carrier and in particular the optical structure thereof will hence not be heated appreciably, so that the internal stresses are largely undisturbed.

In addition to the above-described micro-structured forces, macro-structured forces also occur which are operative over a larger surface area of the plastics information carrier. These may be the result of a unilateral absorption or release of moisture by the information carrier and which result in warping of the information carrier. A comparatively small amount of warping over a large surface area of the plate will, as a rule, not exert a direct influence on the information to be read, since the objective which focuses the laser light can keep the gradually varying distance to the optical structure within the depth of focus, which is a few microns, by a compensating gradual displacement of the objective. In the case in which the carrier warps considerably over a smaller distance, the objective may not be able to follow the varying position of the optical structure during reading and the information carrier is no longer optically readable.

The flat, stiffening, heat-conducting plate can receive the above-mentioned forces without deformation of the plate occurring and hence the information disk manufactured will not warp.

The method in accordance with the invention produces good results in particular if the flat, substantially rigid, heat-conducting plate used is a metal plate or a glass plate of thickness 0.2mm to 2 mm. Owing to the very good thermal conductivity and in addition the excellent thermal capacity, a plate is to be preferred which is manufactured from metal, such as nickel, steel or aluminium.

This applies in particular to an aluminium plate of thickness 0.3mm to 1.3 mm.

In a further favourable embodiment of the invention, the side of the flat plate remote from the information carrier is provided with a second transparent plastics information carrier having a radiation-reflecting optical structure on one side, the said remote side of the flat plate being bonded over all its surface to the radiation-reflecting optical structure of the second information carrier by means of an adhesive.

This results in a double sided information disk which therefore has a doubled playing time. Moreover the further advantage is obtained that there is a fair chance that the macro-structured forces, which may occur in the information carriers situated on both sides of the flat plate, compensate each other at least partly. In this connection it is noted that life tests under extreme atmospheric circumstances have demonstrated that such an information carrier remains substantially flat if a comparatively thin aluminium plate of 0.5 mm is used.

The adhesive used may be of a conventional type, for example, a two-component adhesive. In an advantageous embodiment a radiation-curable lacquer is used, for example, an ultraviolet-curable lacquer based on acrylic acid. The thin liquid lacquer can easily be provided on one of the surfaces to be connected, for example by means of a spraying process or a centrifuging process, that is to say, either on the information-carrying surface of the information carrier, or on the flat, substantially rigid, heat-conducting plate. A rapid curing of the lacquer is possible by exposure *via* the transparent information carrier. It has been found that the radiation-reflecting layer which reflects in particular in the infrared region, still passes sufficient shortwave light, for example ultraviolet light.

If desired, the flat, substantially rigid, heat-conducting plate used may be provided with rein-

forcement ribs on the side remote from the information carrier. An information carrier and a plate may also be used which both have a central aperture so that the resulting information disk has a central aperture.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view of a plastics information carrier used in the method,

Figure 2 is a cross-sectional view of an information carrier obtained according to the invention, and

Figure 3 is a cross-sectional view of another embodiment of an information disk obtained according to the invention.

Reference numeral 1 in Figure 1 denotes a transparent plastics information carrier comprising an optical structure 2 on one side. Information carrier 1 with optical structure 2 has a thickness of approximately 1 mm and is manufactured from transparent polyvinyl chloride/acetate copolymer according to a known pressing process. The optical structure is crenellated and consists of small blocks 3 with intermediate areas 4 the dimensions of which lie in the order of magnitude of 1μ. Optical structure 2 is covered with a vapour-deposited radiation-reflecting aluminium layer 5, approximately 300 Å thick.

On the side of optical structure 2, the information carrier 1 is bonded to a 0.5 mm thick aluminium plate 6 (Figure 2), using a layer of adhesive, not shown, for example, a two-component adhesive.

The resulting information disk is shown in Figure 2. The disk is read optically and in reflection by means of laser light in the direction denoted by an arrow.

Reference numeral 7 in Figure 3 denotes a 0.5 mm thick aluminium plate provided on both sides with plastics information carriers, referenced 8 and 9, respectively. Information carriers 8 and 9 correspond to that shown in Figure 1 and are provided on one side with an optical structure 10, 11 covered by a vapour-deposited aluminium layer, not shown. Information carriers 8, 9 are bonded to plate 7 on the side of the optical structure 10, 11 by means of an adhesive, not shown. The information disk shown in Figure 3 is read from either side in the directions denoted by arrows.

The thickness (approximately 1mm) of the plastics information carriers 1 (Figures 1, 2) and 8, 9 (Figure 3) is amply sufficient to keep dust particles or scratches possibly present on the surface beyond the depth of focus of the objective, not shown, which focuses the reading beam on the optical structures 2 (Figures 1, 2) and 10, 11 (Figure 3).

CLAIMS

1. A method of manufacturing an optically readable information disk, in which a transparent plastics information carrier comprising a radiation-reflecting optical structure on one side is provided, on the side of the optical structure, with a cover plate bonded thereto by means of an adhesive, characterized in that the cover plate is a flat, substantially rigid, heat-conducting plate manufactured from inorganic material and bonded to the information carrier over all its surface.

2. A method as claimed in Claim 1, characterized in that the inorganic material is a metal or glass of thickness 0.2 mm to 2 mm.

3. A method as claimed in Claim 2, characterized in that the inorganic material is aluminium of thickness 0.3 mm to 1.3 mm.

4. A method as claimed in Claim 1, 2 or 3, characterized in that the side of the flat plate remote from the information carrier is provided with a second transparent plastics information carrier having a radiation-reflecting optical structure on one side, the said remote side of the flat plate being bonded over all its surface to the radiation-reflecting optical structure of the second information carrier by means of an adhesive.

5. A method as claimed in Claim 1, characterized in that the adhesive used is a radiation-curable lacquer.

6. An optically readable information disk obtained by using the method as claimed in any of the preceding Claims 1-5.

7. A method of manufacturing an optically readable information disk substantially as described with reference to Figures 2 or 3 of the accompanying drawing.

8. An optically readable information disk substantially as described with reference to Figures 2 or 3 of the accompanying drawing.

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